

**THE EFFECT OF ISOLATION TIME TO THE THERMAL
DEGRADATION OF CELLULOSE NANOFIBER
(CNF) AND CARBOXYMETHYL CELLULOSE
NANOFIBER (CM-CNF)**

ABDUL HAFIDZ BIN MOHD RAFFE

**Final Year Project Report Submitted in
Partial Fulfilment of the Requirement for the
Degree of Bachelor of Science (Hons.) Chemistry
in the Faculty of Applied Sciences
Universiti Teknologi MARA**

JULY 2017

This Final Year Project Report entitled “**The Effect of Isolation Time to The Thermal Degradation of Cellulose Nanofiber (CNF) and Carboxymethyl Cellulose Nanofiber (CM-CNF)**” was submitted by Abdul Hafidz Mohd Raffie, in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Chemistry, in the Faculty of Applied Sciences, and was approved by

Ahmad Husaini Mohamed
Supervisor
B. Sc. (Hons.) Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
72000 Kuala Pilah
Negeri Sembilan

Nurul Huda Abdul Halim
Project Coordinator
B. Sc. (Hons.) Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
72000 Kuala Pilah
Negeri Sembilan

Mazni Musa
Head of Programme
B. Sc. (Hons.) Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
72000 Kuala Pilah
Negeri Sembilan

Date: _____

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENT	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS	ix
ABSTRACT	xi
ABSTRAK	xii
CHAPTER 1 INTRODUCTION	1
1.1 Cellulose	1
1.2 Cellulose Nanofiber (CNF) and the Isolation Method	2
1.3 Cellulose nanofiber derivatives	6
1.4 Oil Palm Biomass	7
1.5 Problem Statement	8
1.6 Significant of Study	9
1.7 Objectives of Study	10
CHAPTER 2 LITERATURE REVIEW	11
2.1 Cellulose Nanofibers (CNF)	11
2.1.1 Isolation method	11
2.2 Characterization of CNF	15
2.2.1 Functional bonding	15
2.2.2 Morphology study	18
2.3 Carboxymethylcellulose (CMC)	21
CHAPTER 3 METHODOLOGY	26
3.1 Materials	26
3.1.1 Raw materials	26
3.1.2 Chemicals	26
3.2 Methods	26
3.2.1 Sample preparation	26
3.2.2 Pre-treatment and bleaching	27
3.2.3 Isolation of cellulose nanofibers (CNF)	27
3.2.4 Conversion of CNF into carboxymethyl cellulose nanofiber (CM-CNF)	28

3.3	Characterization	28
3.3.1	Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy analysis	28
3.3.2	Optical transparency properties analysis	29
3.3.3	Thermalgravimetric analysis	29
CHAPTER 4 RESULTS AND DISCUSSION		30
4.1	Isolation of cellulose nanofiber (CNF)	30
4.1.1	Pre-treatment of oil palm empty fruit bunch (OPEFB) fiber	30
4.1.2	Effect of isolation time on yield and suspension stability of CNF using NaOH treatment	31
4.2	Conversion of CNF into carboxymethyl cellulose nanofiber (CM-CNF)	33
4.3	Characterization of CNF and CM-CNF	34
4.3.1	Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy analysis	34
4.3.2	Optical transparency properties analysis	41
4.3.3	Thermal degradation properties	42
CHAPTER 5 CONCLUSION AND RECOMMENDATION		47
CITED REFERENCES		49
APPENDICES		54
<i>CURRICULUM VITAE</i>		65

ABSTRACT

THE EFFECT OF ISOLATION TIME TO THE THERMAL DEGRADATION OF CELLULOSE NANOFIBER (CNF) AND CARBOXYMETHYL CELLULOSE NANOFIBER (CM-CNF)

In this study, oil palm empty fruit bunch OPEFB fiber biomass was pre-treated using sodium hydroxide (NaOH) and bleaching. The cellulose nanofiber was isolated by alkali treatment with different isolation time (2,4 and 6 hours) and sonicate at 55 °C for 3 hours. The carboxymethyl cellulose nanofiber (CM-CNF) was synthesized using two steps that is alkalization using 20% of NaOH and etherification using monochloroacetic acid (MCA). The CNF and CM-CNF obtained were characterized using Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy, Ultraviolet visible (UV-Vis) spectrophotometer and Thermalgravimetric Analyzer (TGA). result obtained shows that the CNF isolated for 2 hours has a highest percentage yield which is 20.40 % while there is no major different in percentage yield for the CM-CNF synthesized. From the FTIR spectra obtained, the peaks at 1700 cm^{-1} and 1200 cm^{-1} of hemicellulose and lignin were efficiently removed after bleaching process while for CM-CNF, the peak around 1600 cm^{-1} was appeared represent carboxylate (COO^-) group. The determination of nano size in CNF was determine using UV-Vis spectroscopy. Result show that the percentage transmittance for the isolated CNF is more than 95 % at wavelength of 600 nm. From the TG curve obtained, it shows that all samples has a three phases of degradation. The onset degradation temperature for bleached OPEFB is lower than the raw OPEFB due to the removal of hemicellulose and lignin. The CNF isolated for 4 hours has a good thermal stability with the degradation temperature of 311.81 °C and the production of CM-CNF has high thermal stability compared to the CNF isolated.